

## **The Effectiveness of the Attention Training Technique in Reducing Intrusive Thoughts in Schizophrenia: A Case Study**

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### **Abstract**

The aim of this study was to investigate the effectiveness of the attention training technique (ATT) on the frequency of intrusive thoughts experienced by a person with schizophrenia in her daily life. The attentional procedure was designed to attenuate self-focused attention and to reinforce attentional control and consisted of auditory external exercises. Homework practice was included to promote transfer to everyday life. The efficacy and specificity of the ATT were assessed with cognitive, functional, and control measures. The impact of ATT on symptomatology, work functioning, and self-esteem was also measured. Postrehabilitation results showed that, after nine training sessions, there was a reduction in intrusive thoughts for the cognitive and ecological outcome measures. Selective attention, attention switching, and resistance to distractive interference specifically improved. The person reported a reduction in intrusive thoughts in her daily life. In addition, positive symptoms decreased. Finally, a 6-month follow-up assessment revealed the maintenance of most of the beneficial effects in daily life.

**Keywords :** attention training ; intrusive thoughts ; schizophrenia ; cognitive rehabilitation ; daily-life functioning

### **1. Theoretical and Research Basis for Treatment**

In everyday life, we are frequently prone to unwanted mental intrusions that interfere in our ongoing activity. Attentional control shifts away from an ongoing task toward unrelated internal information, such as thoughts or images (Smallwood & Schooler, 2006). Intrusive thoughts are an inherent characteristic of the human mind and adaptive in nature (e.g., they help find a solution or an alternative to a problem; Klinger, 1999). Nevertheless, in certain circumstances, they can interfere with daily-life functioning. Indeed, the shift of attention away from the outside world reduces the awareness of external information leading to superficial representations of the external environment and, as a consequence, to poor performance on activity (Smallwood & Schooler, 2006). For example, engaging in thoughts during a conversation may result in missing important information, or frequent mind wandering during a reading activity may result in poor text comprehension (Schooler, Reichle, & Halpern, 2004). Intrusive thoughts can also play a significant role in a number of psychological disorders (Sarason, Pierce, & Sarason, 1996) and can take various forms such as worry, rumination, obsessions, and negative automatic thoughts (Clark & Rhyno, 2005).

In schizophrenia, mental intrusions occupy an important place in psychotic symptoms, and particularly in hallucinations and delusions. Indeed, the tendency to experience intrusive thoughts has been related to hallucination-proneness (Jones & Fernyhough, 2009). Moreover, studies suggest that there are qualitative similarities between cognitive intrusions and voice hearing, and that these phenomena are only different on a more quantitative manner (Moritz & Larøi, 2008). As suggested by Morrison (2005), hallucinations may be viewed as intrusive thoughts misattributed to an external source. Regarding delusions, they have been associated with dimensions of worry (Morrison & Wells, 2007) and have been considered as a culturally unacceptable interpretation of intrusive thoughts (Morrison, 2001).

Different factors contribute to the development and maintenance of clinically relevant intrusive thoughts. Among others, the persons' metacognitive beliefs (beliefs about thought processes or the meaning given to thoughts) can elicit maladaptive cognitive, behavioral, affective, and physiological responses (e.g., dysfunctional attempts at control), which, in turn, will produce similar intrusions. As a result, a vicious circle can appear (Morrison, 2001).

Impairment of cognitive mechanisms that govern the flow of thoughts, thus leading to a lack of effective self-regulation relative to one's thoughts, is another factor. Among these mechanisms, working memory capacity allows strengthening concentration in daily-life activities that require substantial cognitive resources, and keeping goals consistently accessible (Kane et al, 2007). Inhibition abilities are involved in suppressing unwanted thoughts and enable resistance to interference in conflict situations (Brewin & Smart, 2005; Friedman & Miyake, 2004). Finally, flexibility and selective attention processes allow one to decenter attention that was automatically oriented toward one's thoughts and to focus one's attention on the current task (Engle, 2002).

Despite evidence of the crucial role of intrusive thoughts in schizophrenia, there are surprisingly few cognitive rehabilitation studies that aim at remediating attentional and executive processes underlying this phenomenon. Several studies (López-Luengo & Vásquez, 2003; Silverstein et al., 2009) that examined the effects of interventions for improving attention (attention process training and attention shaping, respectively) on clinical factors in persons with schizophrenia have not shown any beneficial effects on psychotic symptoms. Two other studies targeting executive impairment showed a reduction of positive symptom severity (Lecardeur et al., 2009; Wykes et al, 2003). However, these studies had limitations as they did not target specific and theoretically grounded cognitive processes involved in the symptoms, such as intrusive thoughts.

One promising technique, the attention training technique (ATT; Wells, 2000, 2005), aims at the modification of cognitive and metacognitive factors considered to underlie psychological dysfunction. ATT is based on the "Self-Regulatory Executive Function" model (S-REF; Wells & Matthews, 1994), which suggests a dysfunctional pattern of information processing common to different emotional disorders—the cognitive-attentional syndrome (CAS). This pattern is particularly characterized by self-focused attention (i.e., attention directed to all self-referent information; Ingram, 1990) that becomes excessive, inflexible, and uncontrollable. Thus, through repeated auditory attentional exercises, ATT is designed to attenuate this self-focused attention and to increase flexible attentional control over information processing. The redirection of attention away from the self and toward the external environment allows for the deactivation of perseverative styles of thinking (e.g., rumination and worry), the liberation of resources for the processing of neutral and positive information, and the modification of dysfunctional metacognitive beliefs.

ATT is particularly interesting in the context of reducing intrusive thoughts in schizophrenia. Indeed, this technique directly targets attentional processes underlying excessive attentional self-focus, which is characteristic of schizophrenia and has been related to psychotic symptoms (Ensum & Morrison, 2003; Perona-Garcelán et al, 2008). Moreover, ATT has several advantages, which may help increase the intrinsic motivation to participate in therapy in patients with schizophrenia. First, auditory attentional exercises encompass stimuli close to a real environment, increasing the ecological validity of the rehabilitation. Second, ATT is easy to apply and does not require much time. Finally, exercises can be carried out alone to facilitate a generalization of training outside the rehabilitation context.

ATT has already been successfully applied, using a single-case methodology, in several psychiatric disorders such as panic disorder (Wells, White, & Carter, 1997), social phobia (Wells et al., 1997), recurrent major depression (Papageorgiou & Wells, 2000), and hypochondriasis (Papageorgiou & Wells, 1998). Recently, ATT was applied to a person with schizophrenia who suffered from auditory hallucinations (Valmaggia, Bouman, & Schuurman, 2007). In this study, ATT reduced auditory hallucinations and increased perceived control of them. However, this study contained certain limitations. Because ATT was incorporated following cognitive-behavior therapy (CBT), it was not possible to evaluate the unique contribution of ATT, its specificity and efficacy in schizophrenia. Moreover, no control outcome measures were included in the study, which could have excluded general training effects. In addition, although the aim of ATT is the modification of cognitive factors that underlie excessive self-focus, the effects of this technique on specific cognitive functions were not examined. Finally, self-report measures were applied to assess the effects of ATT on everyday life, whereas direct functional measures were not used. It also should add that the efficacy of ATT has never been studied within the context of reducing of intrusive thoughts in people with schizophrenia, even though such thoughts can be highly distressful for persons and consequently represent an important target of treatment.

Thus, the aim of this study was to investigate the effectiveness of ATT as a unique intervention on the frequency of intrusive thoughts experienced by a person with schizophrenia in her daily life. To this end, specific outcome measures (cognitive and ecological, i.e., measures close to real-world performances) were constructed. To exclude a general training effect, control measures were also administered. The impact of this type of cognitive rehabilitation on cognitive and functional (symptomatology, work functioning) outcomes was investigated with the help of different questionnaires. Moreover, a 6-month follow-up was realized to assess the maintenance of effects.

A single-case methodology was used for two reasons. First, a personalized cognitive rehabilitation program makes it possible to take into account the cognitive characteristics of the person in relation with her or his everyday difficulties (see Levaux et al., 2008). Second, a detailed investigation of a person's profile allows one to isolate those components involved in the beneficial effects of the intervention. Thus, in this study, the assessment of the specificity of ATT was particularly adapted to a person who presented frequent intrusive thoughts that disrupted her daily life. Moreover, her cognitive profile was characterized by impairments of attentional and executive functions contributing to the self-regulation of thoughts. In addition, her intrusive thoughts were hypothesized to be related to her psychotic symptoms, which further dominated her clinical profile. Finally, she was motivated by the fact that the objective of the rehabilitation project was directly aimed at improving her everyday functioning.

## 2. Case Introduction

N. C. is a 32-year-old woman who lives with her 7-year-old daughter. She had completed 11 years of secondary school. At the age of 19, she was diagnosed with paranoid schizophrenia (*Diagnostic and Statistical Manual of Mental Disorders-4th ed. [DSM-IV]* criteria; American Psychiatric Association, 1994). She has had three hospitalizations (total duration of 10 months)—the last one being approximately 3 years before the beginning of the cognitive rehabilitation. At the time of the intervention, her pharmacological treatment consisted of one atypical antipsychotic (risperidone:  $2 \times 4$  mg) and one antiparkinsonian drug (tropatepine:  $3 \times 10$  mg). She was seen by her psychiatrist about once a month. Socially, N. C. had few close friends and essentially saw only members of her family. From 19 to 28 years of age, N. C. carried out different government-sponsored work contracts (apprentice cook, stable groom, and cleaning lady). For the past 4 years, she has been employed part-time in a supported work environment where she carries out different types of tasks such as order and stock management, envelope filling, computer data entry, book lamination, and packaging.

## 3. Presenting Complaints

During an interview about her daily and work functioning, N. C. stated that she frequently became obsessed by her thoughts and that she had difficulty getting them out of her mind. These thoughts could last for several weeks, especially when she was not very well. She expressed having intrusive thoughts of a paranoid nature concerning relationships with her neighbors, coworkers, and supervisors at the work site (e.g., she ruminated about the negative image that others might have of her, and she was suspicious of what others might think of her or say about her); she ruminated about previous failures (e.g., her role as a mother) and worried about future situations (e.g., fears of having rows with her supervisor about her work). Her frequent intrusive thoughts greatly hindered her concentration at work (e.g., she could do nothing for an hour due to her intrusive thoughts). Moreover, her excessive, self-focused attention resulted in increasing her emotional state, which would lead to fits of rapid anger and a lack of control over her behavior (verbal abuse) at work. In her daily life, she also reported difficulties in concentrating when watching movies on television (TV; consequently, she often forgot the content of the movie) or reading books—activities that she had to stop but that she wished to take up again. Thus, the main complaint that N. C. wished to remediate was the presence of frequent intrusive thoughts in her daily and vocational life.

## 4. History

N. C.'s first psychotic symptoms were auditory hallucinations and persecutory delusions. They appeared at the age of 19, leading to a diagnosis of paranoid schizophrenia. N. C. suffered from hallucinations and delusions for several years, but with medication, these symptoms decreased. At the time of the intervention, her symptoms consisted of suspiciousness, excitation, tension, poor impulse control, disturbance of volition, lack of judgment, and feelings of guilt. Socially, N. C. had few close friends and saw only members of her family.

## 5. Assessment

### *Prerehabilitation Cognitive Assessment*

A battery of neuropsychological tests was administered to N. C. A score indicating a deficit was set at  $<-1.65$  for the Z score and at  $<5$  for the percentile score (see Table 1). Concerning working memory, storage (forward digit span; Wechsler, 2001), interference management (Brown-Peterson; Meulemans, Coyette, & Van der Linden, 2007), and updating (Test for Attentional Performance [TAP]; Zimmerman & Fimm, 1994) were preserved. On the contrary, performance on processing load was impaired regarding the alpha span test (Belleville, Rouleau, & Caza, 1998) but not for the backward digit span (Wechsler, 2001). Analysis of executive functioning revealed

deficits related to flexibility (TAP), inhibition (go/no-go TAP, Hayling; Burgess & Shallice, 1996), sensibility to distractive interference (incompatibility TAP), and planning (errand test; Martin, 1972). Regarding attentional functions, performance was impaired on the selective attention test (D2; Brickenkamp, 1998) but not for divided attention (TAP) and sustained attention (continuous performance test; Cornblatt, Risch, Faris, Friedman, & Erlenmeyer-Kimling, 1988). Performance was impaired on the verbal episodic memory test (RL/RI-16; Van der Linden et al., 2004) but not on the visual test (face recognition, MEM-III-3rd edition; Wechsler, 2001). Nonverbal information processing speed was not impaired (digit-symbol coding, Wechsler Adult Intelligence Scale—Third Edition [WAIS-III]; Wechsler, 2000).

**Table I.** Raw and Standardized Scores on Cognitive Assessment

Cognitive test	Pre	Post	Follow-up
Working memory			
Forward span (MEM-III)	6/Z: 0.19	8/Z: 2.04	7/Z: 1.11
Backward span (MEM-III)	5/Z: 0.51	7/Z: 1.99	7/Z: 1.99
Alpha span			
Serial order	<b>5/Z: -3.76</b>	<b>6/Z: -2.8</b>	8/Z: -0.9
Alpha order	<b>3/Z: -1.61</b>	<b>1/Z: -2.57</b>	4/Z: -1.13
Flexibility			
TAP			
Median TR	<b>1040/P: 4</b>	764/P: 24	809/P: 16
SD TR	<b>400/P: 3</b>	20S/P: 18	23S/P: 18
Errors	2/P: < 62	0/P: > 76	3/P: < 50
Inhibition			
Go/no-go TAP			
Median TR	483/P: 62	549/P: 21	<b>614/P: 7</b>
SD TR	<b>103/P: 8</b>	<b>111/P: 7</b>	74/P: 34
Errors	2/P: < 18	0/P: > 46	1/P: > 4
Incompatibility TAP			
Median TR	<b>1040/P: 4</b>	488 <sup>a</sup>	523/P: 10
SD TR	<b>400/P: 3</b>	89,21 <sup>a</sup>	66/P: 76
Errors	2/P: < 62	1 <sup>a</sup>	1/P: < 84
Hayling			
Part B Errors	<b>13/Z: -7.34</b>	<b>12/Z: -6.45</b>	<b>12/Z: -6.45</b>
Planning			
Errand test reference group	<b>&lt;10</b>	<b>&lt;10</b>	<b>&lt;10</b>
Selective attention			
D2			
Processing speed	<b>334/P: 2</b>	426/P: 21	<b>376/P: 8.1</b>
Accuracy	1.2/P: 90	0.02/P: > 90	0.02/P: > 90
Global performance	<b>330/P: 5</b>	416/P: 46	367/P: 1 1,5
Concentration	<b>125/P: 9</b>	172/P: 46	146/P: 21.2
Episodic verbal memory		Parallel version	
RL/RI-16			
Free recall 3	<b>10/Z: -2.33</b>	12/Z: -1	/
Total 3 recalls	<b>26/Z: -1.76</b>	30/Z: -0.96	/

Note: TAP = Test for Attentional Performance; TR = Time Reaction; SD = Standard Deviation.

<sup>a</sup>Unavailable norms; numbers in bold indicate a deficit score

## 6. Case Conceptualization

N. C.'s main complaint in daily and vocational life was heightened self-focused attention with intrusive thoughts, ruminative processing, and attentional bias. Based on these prerehabilitation cognitive performances, N. C.'s difficulties related to intrusive thoughts were interpreted in terms of impaired executive components of attention that control the flow of thoughts. In particular, based on cognitive assessment, it was found that N. C. presented some deficits in working memory capacity, which helps strengthen concentration during those daily-life activities that require substantial cognitive resources and keeping goals consistently active and thereby accessible; focusing her attention on current tasks and selecting the target stimulus; shifting her attention between stimuli and thus shifting her attention away from an automatic, internally oriented focus; inhibiting automatic responses (verbal and motor); and resisting distractive interferences (such as intrusive thoughts). Therefore, N. C.'s poor self-regulation of her own thoughts may have been due, at least in part, to these impaired

cognitive mechanisms, which further explains the development and maintenance of clinically relevant intrusive thoughts in N. C. Based on this, it was agreed with N. C. that the main goal of the cognitive rehabilitation program was to attenuate this self-focused attention and to learn to increase attentional control and mental flexibility with the help of the ATT (Wells, 2000, 2005).

## **7. Course of Treatment and Assessment of Progress**

### *Rehabilitation Program*

Nine ATT sessions were realized. The first ATT session constituted several objectives: (a) examining N. C.'s self-focused attention, (b) explaining the aim of the procedure, (c) providing the theoretical rationale of ATT and explaining the technique, and (d) verifying the credibility of the rationale in the eyes of N. C. and reinforcing it if necessary. Moreover, N. C. received a sheet containing this information so that she could consult it when required. For the eight following sessions, the therapist sat behind N. C. and during the procedure, N. C. was asked to fix her gaze on a visual point (a light cast on the wall). Three types of external attention exercises with auditory stimuli were progressively administered within and across sessions. For selective attention exercises, N. C. had to focus her attention (for 15 s) on a sound designated by the therapist, followed by a 5-s pause. During the exercise, additional competitive sounds were introduced as the therapist named them, and this continued until the end of the training session. Once N. C. learned to focus her attention on one sound at a time, she was required to learn to switch her attention to different noises. Finally, in the third type of exercise, N. C. practiced her divided attention, that is, she tried to perceive different sounds at the same time. To maintain attentional demands at a high level throughout the application of the procedure, the level of difficulty was increased by progressively identifying less distinct sounds, gradually increasing the speed of attention switching, and, finally, attending to a greater number of different sounds at the same time. The procedure was similar to the original version (Wells, 2000), except that the three types of attentional exercises were progressively administered across sessions to control for the learning pace.

Four sounds of varied intensity (tapping, metronome, background noise of a computer, running water) were used in the same room at different spatial locations (left, right, front, rear) relative to N. C.'s position. Two additional sounds outside the room (radio, fan) were also identified. The number of sounds was set to ensure that the attentional demands were considerable enough during the procedure.

After each exercise, N. C. was asked to assess how well she practiced her attention on a scale from 0 = *not at all* to 10 = *very well*. At this stage, any difficulties she encountered could be pointed out and discussed. It was also important to emphasize the aim of ATT, which is not to suppress thoughts outside of awareness but, rather, to allocate attention in a flexible manner. Therefore, it was not a disadvantage to experience intrusive thoughts during the exercises, as they offered a background noise that rendered the focus of attention on the external sounds more difficult. When the assessment of the easiness to carry out the task reached 80%, the next exercise was applied. The duration of exercises lasted approximately 15 to 30 min according to the level of difficulty with which N. C. realized each exercise.

To learn how to use ATT herself, N. C. had to practice this technique at home once to twice a day for 10 to 15 min. Homework exercises were identical to those exercises applied during the training session. A sheet with instructions and the scale for assessing how well she practiced her attention was given to N. C. to help her to do the exercises. Five sounds were used in N. C.'s environment: clock, radio, running water in her kitchen, TV in the living room, and street sounds. At the beginning of each training session, the therapist gathered and discussed N. C.'s commentaries and difficulties with her homework exercises. At the end of each training session, the next homework exercises were discussed in detail.

### *Design*

The efficacy of ATT was measured with an A-B protocol consisting of three stages: a baseline phase for a 3-week period to assess the stability of outcome performances, an attention training phase during which the procedure was administered for a 5-week period, and a postrehabilitation phase for a 3-week period to assess the stability of outcome changes. Cognitive assessment was administered at pre- and postrehabilitation to determine if changes were observed on cognitive performances. The efficacy and specificity of ATT were also assessed with three types of outcome measures: ecological, cognitive, and control. For each task (as described in greater detail below), six parallel measures with different stimuli were constructed (three administered at baseline and three at postrehabilitation with a 1-week interval between each measure) to minimize practice effects. A questionnaire measuring the perceived ability to control intrusive thoughts was administered 3 times at pre- and

postrehabilitation. Finally, measures assessing psychiatric symptoms and work functioning were administered at pre- and postrehabilitation.

### *Outcome Measures Ecological Measures*

*Text comprehension.* A text comprehension task was chosen to examine the attentional control targeted by ATT. Indeed, during reading, mind wandering often occurs, that is, the attentional control shifts away from the text toward internal information. Consequently, frequent mind wandering reduces the awareness of external information leading to superficial representations and to poor comprehension performance (Smallwood & Schooler, 2006). Mind wandering can thus reflect self-focused attention and constitutes an interesting phenomenon for examining attentional control (Kane et al., 2007). Moreover, as text reading was a daily-life activity that caused problems for N. C. (because of impaired concentration), it was pertinent to include this task.

*Task and stimuli:* The text comprehension task was constructed based on tasks used in Lyubomirsky, Kasri, and Zehm (2003) and Schooler, Smallwood, McSpadden, and Reichle (2005, cited in Smallwood & Schooler, 2006). Six texts (from the same author) were chosen because of their very descriptive nature eliciting mind wandering (Giambra & Grodsky, 1992). The texts did not differ according to their number of words (35 min to read). They were divided into paragraphs, which was presented on a different computer screen. Mind wandering was sampled according to a probe-caught procedure at predefined intervals (every 2 min) throughout the task as this procedure has been shown not to have an effect on the frequency of mind wandering during a comprehension text task (Schooler et al., 2004). A screen with the question "Were your thoughts wandering?" was presented, and N. C. was asked to respond by pressing the keyboard key corresponding to "yes" or "no." Before the beginning of the task, N. C. learned to distinguish between (a) a wandering thought, that is, a thought not related to the activity and that comes into mind unintentionally and (b) a nonwandering thought, that is, a thought that is directly provoked by the activity, related to the activity, or directed to the realization of the activity.

*Measures:* (a) Frequency of mind wandering and (b) score on a multiple choice recognition test. *Hypothesis:* Due to an increase in attentional control, we hypothesized that, at postrehabilitation, there would be a decrease in mind wandering and a higher score on the recognition test.

*Story learning.* For this second task, the construction of detailed memories depends on the executive control of attention during encoding. Indeed, mind wandering is susceptible to occur during this phase and could thus lead to memories of poorer quality (Smallwood & Schooler, 2006).

*Task and stimuli:* N. C. had to read a story aloud and then recall the most details as possible. A delayed recall was administered after a 15-min delay. The stories did not differ in terms of length and number of items (assessed according to two independent judges).

*Measures:* Immediate and delayed information recall.

*Hypothesis:* Due to a better attentional control after attention training, we hypothesized that the decoupling of attention would be less susceptible to occur during the information-encoding phase, thus resulting in an improvement of the quality of memories.

### *Cognitive Measures*

***Digit ordination of Rey*** (Rey, Marchand, Rappaz, Richelle, & Schaechtlin, 1957): Mind wandering has been reported when people carry out nondemanding vigilance tasks (Giambra & Grodsky, 1992). Indeed, tasks that rely on few controlled processes may leave many resources available for mind wandering (Smallwood & Schooler, 2006).

*Task and stimuli:* N. C. was asked to ordinate a series of seven digits by increasing order. This task lasted 20 min. Mind wandering was sampled by the therapist according to the probe-caught procedure with predefined intervals (every 2 min).

*Measures:* (a) Frequency of mind wandering.

*Hypothesis:* Due to an increase in attentional control, we hypothesized a decrease of mind wandering after rehabilitation.

### *Control Measures*

**Word-List Learning.** To assess if ATT had a specific effect (and, furthermore, to exclude a general effect of training), we included a control task that did not involve processes targeted by ATT. Therefore, if no improvement on this task was observed postintervention, then this would suggest a specific, nongeneralized effect. To this end, a control task involving episodic memory, and in particular word-list learning (which was impaired in N. C.), was constructed. It involved a high stimulus presentation rate to decrease the possibility of mind wandering (Grodsky & Giambra, 1990). Indeed, as the word-list learning and mind wandering compete for the same limited attentional resources, and as more resources are allocated to the primary task, this will result in fewer resources being available to support mind wandering (Smallwood & Schooler, 2006).

**Task and stimuli:** N. C. had to read aloud 15 abstract words presented on a computer screen one-by-one at 1 word per second. Five trials with recall were administered. A delayed recall was given after a distraction task (count backward by 3 s) that lasted 30 s. Finally, N. C. was given a forced-choice recognition test. The number of letters, the lexical frequency, and the degree of imagery were controlled for all six lists. **Measures:** Recall on the first and fifth trial, total recall (on five trials), and delayed recall. **Hypothesis:** It was hypothesized that the rapid presentation and the active phase of the information encoding would render the apparition of intrusive thoughts and the decoupling of attention less frequent. Consequently, we hypothesized that an effect of attentional control training would not be observable on this task, and so no significant improvement of performance was expected at postrehabilitation.

### *Questionnaire*

The French version of the Thought Control Ability Questionnaire (TCAQ, Luciano, Algarabel, Tomas, & Martinez, 2005; French validation, Gay, d'Acremont, Schmidt, & Van der Linden, 2007) was used to obtain a measure of the perceived capacity to control images, thoughts, and impulses. The French version consists of 23 items, and N. C. answered each item using a 5-point Likert-type scale ranging from 1 = *completely disagree* to 5 = *completely agree*. A higher score reflects better perceived control over thoughts. The French version of TCAQ possesses good internal consistency, reliability, and convergent validity (Gay et al., 2007).

### *Outcome Measures In Daily and Vocational Life Psychiatric Symptoms*

**Positive and Negative Syndrome Scale (PANSS):** Clinical symptoms were assessed using a French adaptation of the PANSS (Lépine, Piron, & Chapatot, 1989) by an independent clinician.

### *Work Functioning*

**The Work Behavior Inventory (WBI):** The WBI (which demonstrates internal consistency and good concurrent, discriminant, and predictive validity, Bryson, Bell, Lysaker, & Zito, 1997; French adaptation, Levaux et al., 2007) is composed of 35 sentences that characterize various types of work behavior, which are divided into five subscales of seven items (social skills, cooperativeness, work habits, work quality, and personal presentation). N. C.'s work-site supervisor completed the inventory using a 5-point Likert-type scale ranging from 1 = *consistently an area needing improvement* to 5 = *consistently an area of superior performance*.

### *Results*

**Cognitive Assessment.** The postrehabilitation assessment (see Table 1) revealed improvements in flexibility, resistance to distractive interferences, selective attention, and verbal episodic memory. Impaired performance in inhibition of motor and verbal responses, and planning, showed no change. Finally, performance in storage and the processing load component of working memory also improved, except for the alpha span task.

### *Outcome Measures*

#### *Stability of Outcome Measures*

**Prerehabilitation measures.** N. C.'s performances on the outcome measures were stable across the three prerehabilitation assessments except for (a) the recognition score on text comprehension, which significantly increased; (b) mind-wandering frequency on digit ordination, which showed a significant increase at the second baseline; (c) scores on the word-list learning task (first, fifth, and total recall), which showed a significant increase; and (d) the delayed recall on word-list learning task and the immediate item recall on the story-learning

task, which significantly decreased between the first and second baselines.

*Postrehabilitation measures.* N. C.'s performances on the outcome measures were stable across the three postrehabilitation assessments except for (a) mind-wandering frequency on text comprehension and digit ordination, which both significantly decreased; (b) the recognition score on text comprehension, which increased; (c) scores on the word-list learning task (fifth recall and total recall), which significantly increased; and (d) the immediate and delayed item recall on the story-learning task, which both showed a significant decrease.

#### *Outcome Measure Comparisons*

A statistical analysis using chi-square tests (see Brunsdon, Coltheart, & Nickels, 2005) was carried out to compare the scores on the outcome measures and questionnaires at pre- and postrehabilitation (see Tables 2 and 3). For this, scores were averaged for ecological, cognitive, and control measures and for TCAQ to obtain a representation of performances on the outcome measures at the two assessment times.

*Ecological—Text comprehension:* A significant decrease of mind-wandering frequency was observed after rehabilitation,  $\chi^2(1) = 7.88, p = .005$ ; scores on the recognition test did not significantly change. *Ecological—Learning of a story:* All scores significantly improved after the rehabilitation, immediate recall:  $\chi^2(1) = 15.84, p < .001$ ; delayed recall:  $\chi^2(1) = 11.67, p < .001$ . *Cognitive—Digit ordination:* The frequency of mind wandering decreased significantly,  $\chi^2(1) = 11.29, p < .001$ . *Control—Learning of word-list:* Except for the first recall score, all the scores showed a significant decrease after the rehabilitation, fifth recall:  $\chi^2(1) = 6.1, p = .01$ ; total recall:  $\chi^2(1) = 5.29, p = .02$ ; delayed recall:  $\chi^2(1) = 17.11, p < .001$ . *TCAQ:* The total score significantly improved,  $\chi^2(1) = 8.29, p < .004$ .

**Table 2.** *Averaged Scores for Outcome Measures*

Outcome measures	Pre	Post
Ecological:Text comprehension		
Mind-wandering frequency (%)	45 (42-47-47)	26 <sup>a</sup> (36-38-6)
Recognition test score (%)	61 (41-78-64)	61 (45-59-77)
Ecological: Story learning		
Immediate item recall (%)	31 (40-21-33)	59 <sup>a</sup> (60-66-51)
Delayed item recall (%)	28 (35-23-26)	51 <sup>a</sup> (61-47-47)
Cognitive: Digit ordination		
Mind-wandering frequency (%)	33 (20-50-30)	13 <sup>a</sup> (20-20-0)
Control:Word-list learning		
Recall first trial (%)	47 (40-53-57)	36 (33-33-40)
Recall fifth trial (%)	78 (67-80-87)	62 <sup>a</sup> (47-60-80)
Total recall (%)	67 (62-64-76)	51 <sup>a</sup> (43-48-62)
Delayed recall (%)	71 (80-47-87)	42 <sup>a</sup> (27-40-60)
Questionnaire:TCAQ		
Score (/105)	72 (71-74-71)	90 <sup>a</sup> (90-89-92)

Note: TCAQ = Thought Control Ability Questionnaire.

<sup>a</sup>Significant change ( $p < .05$ ); raw scores in parentheses refer to the three assessments at 1-week intervals at pre- and postrehabilitation.

**Table 3.** *Scores on Daily and Vocational Outcome Measures*

Daily/vocational measures	Pre	Post	Follow-up
PANSS			
Total score (/210)	67	54	43 <sup>a</sup>
Positive symptoms (/49)	17	11 <sup>b</sup>	9 <sup>a</sup>
Negative symptoms (/49)	14	18	12
General psychopathology (/112)	36	25	22 <sup>a</sup>
WBI			
Total score (/175)	92	103	113
Socials skills (/35)	15	19	20 <sup>a</sup>
Cooperativeness (/35)	20	20	23
Work habits (/35)	15	17	20 <sup>a</sup>
Work quality (/35)	22	25	27 <sup>a</sup>
Personal presentation (/35)	20	22	23

Note: PANSS = Positive and Negative Syndrome Scale; WBI = Work Behavior Inventory. <sup>a</sup>Pre versus follow-up significant change. <sup>b</sup>Pre



versus post significant change.

### *Daily and Vocational Outcome Measures*

*Psychiatric symptomatology:* A significant decrease in positive symptomatology was observed,  $\chi^2(1) = 4.15, p = .04$ . No significant change was found for negative symptoms, general psychopathology, and the total score on the PANSS.

*Work functioning:* No significant change was noted on the WBI subscales.

### *Qualitative Self-Assessment*

During ATT sessions and postrehabilitation interviews, N. C. mentioned different improvements in her daily life. In particular, concentration improved: "I was talking with my neighbor and when my mind started wandering, I wasn't listening to her and just looked at her, so I thought about focusing outward and then I was able to listen to the end of the conversation." N. C. indicated that she used the technique at work: She was able to better shift her attention from her thoughts toward her work. She also practiced the technique at home when ruminating about familial relations: "I had a row with my daughter that made me sad and I kept thinking about it. So I said to myself: 'focus outward' and it went well." Moreover, N. C. complained a lot about being easily angry, and she tried to apply attention switching to learn to be calmer: "If I become angry, I go to the kitchen and I try to practice my exercises."

## **8. Complicating Factors**

N. C. was required to practice ATT at home, between once and twice a day. In the beginning, she had problems carrying out homework at this rate due to the fact that she had to take care of her daughter and worked part-time. Therefore, she reduced doing homework exercises to once every 2 days. The therapist discussed the importance of doing these exercises with her, and about how to carry out the exercises in her daily life. It should also be noted that, to directly assess N. C.'s intrusive thoughts in her daily life, an Experience Sampling Method (see Myin-Germeys & Van Os, 2007) was carried out. Unfortunately, however, the sampling applied in N. C.'s daily life was not sensitive enough to detect her intrusive thoughts. Rendering the sampling procedure more sophisticated (e.g., mixed probe-caught and self-caught intrusive thoughts) might have helped in making the measure more sensitive.

## **9. Access and Barriers to Care**

Before starting ATT, it is important to take into account the patient's level of insight regarding his or her psychotic symptoms and, if necessary, propose CBT to reduce the acute psychotic symptoms and improve coping with the illness. Moreover, the relatively straightforward treatment rationale behind ATT (e.g., the aim of the procedure is not to suppress internal events but to practice focusing attention flexibly in a particular way) should be clear to the person and accepted. Therefore, it is important to closely monitor the patient's personal goals related to using the strategy. Probably as a result of an understanding, a good engagement with the training will be maintained during treatment. Finally, the presence of cognitive deficits in people with schizophrenia, such as memory difficulties, might require adapting the procedure. This could involve, for example, writing down the instructions for the person to take home and providing a homework form to structure the homework practice. Significant other adaptations might also include adjusting the pace of the training and the number of sounds to practice.

## **10. Follow-Up**

Between postassessment and the 6-month follow-up, N. C. had not received any other intervention, and there was no change in neuroleptic treatment. The follow-up scores on questionnaires were compared with scores at pre- and postrehabilitation using a chi-square statistical analysis (see Table 3).

### *Cognitive Assessment*

All improvements observed at postrehabilitation concerning the storage and processing load of working memory, flexibility, resistance to distractive interferences, selective attention (except for the processing speed), and verbal episodic memory was maintained (see Table 1). Scores on alpha span also improved. No change of performance was noted for motor and verbal inhibition, and planning, which remained impaired.

### *Daily and Vocational Life Outcome Measures*

*Post versus follow-up.* Perceived control on thoughts (TCAQ) decreased significantly,  $\chi^2(2)=17.15, p < .001$ . No significant change was observed on the symptomatology (PANSS) and work functioning (WBI).

*Pre versus follow-up.* The score on the TCAQ did not show a significant change. Positive symptomatology showed a significant decrease,  $\chi^2(1) = 6.49, p = .01$ , whereas general psychopathology,  $\chi^2(1) = 3.74, p = .05$ , and the total score,  $\chi^2(1) = 3.74, p = .05$ , indicated a marginally significant decrease. Negative symptoms remained significantly stable. Regarding functioning at work, N. C. obtained better scores on different components of work behavior: social skills,  $\chi^2(1) = 3.92, p = .04$ ; work habits,  $\chi^2(1) = 3.92, p = .04$ ; and work quality,  $\chi^2(1) = 4.67, p = .03$ . The other components remained stable.

### **11. Treatment Implications of the Case**

The aim of the present study was to test the efficacy of an ATT in reducing intrusive thoughts in a person with schizophrenia. The ATT was applied alone without any other type of intervention to isolate its specific effect. The results from the cognitive assessment indicated that the attention training had a beneficial effect on a number of executive and attentional functions: selective attention, flexibility, and resistance to distractive interferences. Working memory and verbal episodic memory also showed an improvement. Specific outcome measures (text comprehension, story learning, and digit ordination) demonstrated enhanced attentional control and a reduction of intrusive thoughts. In everyday life, beneficial repercussions were observed on concentration, perceived control on thoughts, and psychotic symptoms. Control measures did not improve, suggesting no general training effects. Finally, assessment 6 months after the intervention revealed that most of the beneficial effects in daily life and work functioning were maintained.

Regarding improvement in cognitive functions, several results merit discussion. First, N. C. showed a better performance for two tasks involving attentional functions directly targeted by ATT: selective attention (in particular, a more efficient global performance with a constant processing speed, and improved concentration) and mental flexibility (specifically, a greater rapidity of attention switching between stimuli with less variability throughout the performance and without errors). Second, N. C. responded more rapidly (and with less variability and errors) during the distractive interference task. This improvement could be explained by the fact that during attentional exercises, N. C. learned to resist interfering sounds to focus on the target sound. Third, an increase in the capacity of the storage and processing load in working memory was observed. This may be due to a decrease in competition for attentional resources between thoughts and ongoing task requirements after rehabilitation, which resulted in freeing working memory resources (Klein & Boals, 2001). However, it should be noted that the improvement was not generalized to the alpha order score, which may have been a more demanding condition for N. C. Finally, findings indicated that verbal episodic memory (not directly remediated by the intervention) also improved—in particular, regarding the information learning phase. This improvement could be explained by a better management of available attentional resources for the formation of episodic memory representation (e.g., Craik, 2001). The increase in working memory storage capacity might also explain the beneficial effects observed for episodic memory because episodic memory and working memory are closely related on a theoretical level (Ranganath, Cohen, & Brozinsky, 2005).

In terms of outcome measures, the efficacy of the ATT on attentional control was also demonstrated by the diminution of mind-wandering frequency for the ecological (text comprehension) and cognitive (digit ordination) outcome measures. Regarding the story-learning task, N. C.'s immediate recall at postrehabilitation was more detailed and more complete compared with prerehabilitation. These improvements had some repercussions on delayed recall, which also resulted in memories with richer quality. These results are in accordance with our hypothesis that the intervention would improve attentional control, which intervenes during the information-encoding phase. They are also in line with the improved learning performance observed on the verbal episodic memory test at cognitive assessment.

Importantly, these beneficial effects also transferred to N. C.'s daily life. In particular, based on results from interviews and subjective questionnaires, she reported improved concentration and attentional control of her intrusive thoughts in various daily and professional life situations. Higher effective control on thought may have lead N. C. to experience less intrusive thoughts and to engage less in thought suppression, which is an ineffective coping response (Peterson, Klein, Donnelly, & Renk, 2009). Interestingly, the perceived capacity of controlling thoughts might be an important predictive factor in the experience of psychological symptoms in schizophrenia (Peterson et al., 2009). N. C. also showed a significant decrease in positive symptomatology after rehabilitation, in particular, for delusions, suspiciousness/persecution, and excitation. Thus, in aiming to improve attentional

control, the intervention further had a beneficial effect on the patient's positive symptoms, that is, intrusive thoughts of a paranoid nature. Other (general psychopathology) symptoms (anxiety, tension, poor impulse control, disturbance of volition, and lack of judgment) also showed a significant decrease. This finding is in accordance with what N. C. expressed during the last rehabilitation sessions: The application of attention switching gave her a certain degree of peace of mind, whereas before the rehabilitation she tended to become angry rapidly. Finally, no change was noted on vocational functioning.

The beneficial effects of the attention training may be considered as relatively specific based on the observation that certain impaired cognitive functions at prerehabilitation did not improve at postrehabilitation. First, dominant motor and verbal response inhibition remained impaired. These results could be explained by the fact that ATT does not train this inhibition capacity but, rather, aims at promoting active acceptance of thoughts and learning more effective cognitive-control strategies, in contrast with a "thought suppression" strategy. Indeed, according to the rationale of the intervention, inhibition of thoughts is considered counterproductive as it will produce paradoxical effects resulting in increased frequency of these unwanted mental intrusions (Wegner & Zanakos, 1994). Second, scores on the errand test also remained impaired. In this test, the person must operate a strategic choice in ordering the errands, while at the same time keeping instructions in mind. Attentional resources are necessary to engage strategies to resolve a nonroutine action. However, it seems that the improvements in attentional capacities were not sufficient to compensate for difficulties on this task, which involves higher order functions, such as strategic organization (i.e., make a plan, identify alternatives approaches, adjust behavioral responses according to the contextual constraints). Finally, in keeping with our hypothesis, the word-list learning task (control measure) did not improve after rehabilitation. For this task, the high stimulus presentation rate probably resulted in mobilizing large amount of resources, reducing the decoupling of attention, and, thus, reducing the switching of attention from the task.

After a 6-month period, the various beneficial effects of the intervention were maintained. Specifically, improvements obtained on cognitive functions were still clearly present. Psychiatric symptomatology (positive and general psychopathology) still showed a decrease. In daily life, N. C. continued to practice attentional flexibility. Moreover, she stated that she was able to concentrate when reading books without any difficulties, which at prerehabilitation was mentioned as an activity that she wanted to take up again. Improved attentional capacities might have lead to a richer encoding of information, which might have further motivated N. C. to continue reading texts. Regarding work functioning, improvement on certain components of work behavior appeared after 6 months. In particular, N. C. presented better social skills, which could be due to a decrease in her impulsive behavior. Work habits and work quality also showed an improvement. However, it is important to mention that other factors related to the workplace (beyond the rehabilitation) might have also influenced these improvements.

Perceived control on intrusive thoughts and the application of attentional switching seemed to have somewhat declined over the 6-month follow-up period. A possible interpretation could be that N. C. kept certain maladaptive metacognitive beliefs concerning her intrusive thoughts. Matthews and Wells (2000) proposed that the ATT instructions that modify the focus of attention may lead people to challenge dysfunctional metacognitions via the reestablishment of adaptive alternative plans. However, the results of this study suggest that the attention training might not have sufficiently targeted the metacognitive factors, which are necessary if long-term effects are to be maintained. These difficulties could also be related to the absence of reminder sessions during the 6 months after the intervention. In addition, ATT was originally intended as a technique to be used as part of a more complete metacognitive therapy (Wells, 2007) to modify metacognitive beliefs about thoughts. In the present study, only ATT was included to examine the specific effects of this intervention.

It is important to mention the limitations of the study. First, mind wandering was only assessed based on verbal reports. It would be interesting to assess mind wandering more objectively by using measures such as response time or electrocortical activity (as recommended by Smallwood & Schooler, 2006). Second, performances on certain outcome measures at pre- and postrehabilitation were not stable, such as the self-report of mind wandering. This problem is related to the highly variable nature of the phenomenon itself. Moreover, the fact that these measures were also variable at postintervention further underlines its unstable nature.

## **12. Recommendations to Clinicians and Students**

This study, in addition to Valmaggia et al. (2007), demonstrates that ATT is a valuable intervention strategy for people with psychotic symptoms and merits further investigation. The use of a multiple case study design might be an interesting avenue for future studies—in particular, to determine cognitive, clinical, and functional profiles of persons with schizophrenia susceptible to benefit from ATT and also profiles of those not susceptible to

benefit. Finally, including techniques for modifying dysfunctional metacognitive beliefs (Wells, 2000) would surely prove interesting to assess their impact on the maintenance of the effects of ATT.

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## References

- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Belleville, S., Rouleau, N., & Caza, N. (1998). Effect of normal aging on the manipulation of information in working memory. *Memory & Cognition*, 26, 572-583.
- Brewin, C. R., & Smart, L. (2005). Working memory capacity and suppression of intrusive thoughts. *Journal of Behavior Therapy and Experimental Psychiatry*, 36, 61-68.
- Brickenkamp, R. (1998). Le test d2 d'attention concentrée. Paris: Les Editions du Centre de Psychologie Appliquée.
- Brunsdon, R., Coltheart, M., & Nickels, L. (2005). Treatment of irregular words spelling in developmental surface dysgraphia. *Cognitive Neuropsychology*, 22, 213-251.
- Bryson, G., Bell, M. D., Lysaker, P., & Zito, W. (1997). The Work Behavior Inventory: A scale for the assessment of work behavior for clients with severe mental illness. *Psychiatric Rehabilitation Journal*, 20, 47-56.
- Burgess, P. W., & Shallice, T. (1996). Response suppression, initiation, and strategy use following frontal lobe lesions. *Neuropsychologia*, 34, 263-276.
- Clark, D. A., & Rhyno, S. (2005). Unwanted intrusive thoughts in nonclinical individuals. In D. A. Clark (Ed.), *Intrusive thoughts in clinical disorders: Theory, research, and treatment* (pp. 1-29). New York, NY: Guilford.
- Comblatt, B. A., Risch, N., Faris, J., Friedman, G., & Erlenmeyer-Kimling, D. (1988). The continuous performance test, identical pairs version (CPT-IP): I. New findings about sustained attention in normal families. *Psychiatry Research*, 26, 223-238.
- Craik, F. I. M. (2001). Effects of dividing attention on encoding and retrieval processes. In H. L. Roediger (Ed.), *The nature of remembering: Essays in honor of Robert G. Crowder* (pp. 55-68). New York, NY: American Psychological Association.
- Engle, R. W. (2002). Working memory capacity as executive function. *Current Directions in Psychological Science*, 11, 19-23.
- Ensum, I., & Morrison, A. P. (2003). The effects of focus of attention on attributional bias in patients experiencing auditory hallucinations. *Behaviour Research and Therapy*, 41, 895-907.
- Friedman, N. P., & Miyake, A. (2004). The relations among inhibition and interference control functions: A latent-variable analysis. *Journal of Experimental Psychology: General*, 133, 101-135.
- Gay, P., D'Acremont, M., Schmidt, R. E., & Van der Linden, M. (2007). Validation of a French adaptation of the Thought Control Ability Questionnaire. *European Journal of Psychological Assessment*, 24, 101-107.
- Giambra, L. M., & Grodsky, A. (1992). The influence of age on the frequency of spontaneous task-unrelated thought intrusions during reading. *Imagination, Cognition and Personality*, 11, 367-379.
- Grodsky, A., & Giambra, L. M. (1990). The consistency across vigilance and reading tasks of individual differences in the occurrence of

task-unrelated and task-related images and thoughts. *Imagination, Cognition and Personality*, 10, 39-52.

Ingram, R. E. (1990). Self-focused attention in clinical disorders: Review and a conceptual model. *Psychological Bulletin*, 107, 156-176.

Jones, S. R., & Fernyhough, C. (2009). Rumination, reflection, intrusive thoughts, and hallucination-proneness: Towards a new model. *Behaviour Research and Therapy*, 47, 54-59.

Kane, M. J., Brown, L. H., McVay, J. C., Silvia, P. J., Myin-Germeys, I., & Kwapil, T. R. (2007). For whom the mind wanders, and when: An experience-sampling study of working memory and executive control in daily life. *Psychological Science*, 18, 614-621.

Klein, K., & Boals, A. (2001). The relationship of life event stress and working memory capacity. *Applied Cognitive Psychology*, 15, 565-579.

Klinger, E. (1999). Thought flow: Properties and mechanisms underlying shifts in contents. In J. A. Singer & P. Salovey (Eds.), *At play in the fields of consciousness: Essays in the honor of Jerome L. Singer* (pp. 29-50). Mahwah, NJ: Erlbaum.

Lecardeur, L., Stip, E., Giguere, M., Blouin, G., Rodriguez, J.-P., & Champagne-Lavau, M. (2009). Effects of cognitive remediation therapies on psychotic symptoms and cognitive complaints in patients with schizophrenia and related disorders: A randomized study. *Schizophrenia Research*, 111, 153-158.

Lépine, J. P., Piron, J. J., & Chapatot, E. (1989). Factor analysis of the PANSS in schizophrenia patients. In C. N. Stefanis, C. R. Soltados, & A. D. Rabavilas (Eds.), *Psychiatry today: Accomplishments and promises*. Amsterdam, Netherlands: Experta Medica.

Levaux, M. N., Larai, F., Offerlin-Meyer, I., Danion, J. M., Van der Linden, M., & Bonnefond, C. (2007). *Adaptation française du Work Behavior Inventory* [French adaptation of the Work Behavior Inventory]. Unpublished manuscript, University of Liège, Inserm Unit 666, Strasbourg.

Levaux, M. N., Vezzaro, J., Larai, F., Offerlin-Meyer, I., Danion, J. M., & Van der Linden, M. (2008). Cognitive rehabilitation of the updating sub-component of working memory in schizophrenia: A case study. *Neuropsychological Rehabilitation*, 19, 244-273.

Lopez-Luengo, B., & Vazquez, C. (2003). Effects of attention process training on cognitive functioning of schizophrenic patients. *Psychiatry Research*, 119, 41-53.

Luciano, J., Algarabel, S., Tomas, J., & Martinez, J. (2005). Development and validation of the Thought Control Ability Questionnaire. *Personality and Individual Difference*, 38, 997-1008.

Lyubomirsky, S., Kasri, F., & Zehm, K. (2003). Dysphoric rumination impairs concentration on academic tasks. *Cognitive Therapy and Research*, 27, 309-330.

Martin, R. (1972). *Le test des commissions. Epreuve d'adaptation méthodique*. Bruxelles, Belgium. Matthews, G., & Wells, A. (2000). Attention, automaticity, and affective disorder. *Behavior Modification*, 24, 69-93.

Meulemans, T., Coyette, F., & Van der Linden, M. (2007). *Adaptation et validation du test informatisé de Brown-Peterson* [Adaptation and validation of computerized Brown-Peterson test]. Unpublished manuscript, University of Liège, Belgium.

Moritz, S., & Larai, F. (2008). Differences and similarities in the sensory and cognitive signatures of voice-hearing, intrusions and thoughts. *Schizophrenia Research*, 102, 96-107.

Morrison, A. P. (2001). The interpretation of intrusions in psychosis: An integrative cognitive approach to hallucinations and delusions. *Behavioural and Cognitive Psychotherapy*, 29, 257-276.

Morrison, A. P. (2005). Psychosis and the phenomenon of unwanted intrusive thoughts. In D. A. Clark (Ed.), *Intrusive thoughts in clinical disorders: Theory, research, and treatment* (pp. 175-198). New York, NY: Guilford.

Morrison, A. P., & Wells, A. (2007). Relationships between worry, psychotic experiences and emotional distress in patients with schizophrenia spectrum diagnoses and comparisons with anxious and non-patients groups. *Behaviour Research and Therapy*, 45, 1593-1600.

Myin-Germeys, I., & van Os, J. (2007). Stress-reactivity in psychosis: Evidence for an affective pathway to psychosis. *Clinical Psychology Review*, 27, 409-424.

Papageorgiou, C., & Wells, A. (1998). Effects of training on hypochondrias: A briefcase series. *Psychological Medicine*, 28, 193-200.

Papageorgiou, C., & Wells, A. (2000). Treatment of recurrent major depression with attention training. *Cognitive and Behavioral Practice*, 7, 407-413.

Perona-Garcelan, S., Cuevas-Yust, C., García-Montes, J., Perez-Alvarez, M., Ductor-Recuerda, M. J., & Salas-Azcona, R., . . . Rodriguez-Martin, B. (2008). Relationship between self-focused attention and dissociation in patients with and without auditory hallucinations. *Journal of Nervous and Mental Disease*, 196, 190-197.

- Peterson, R. D., Klein, J., Donnelly, R., & Renk, K. (2009). Predicting psychological symptoms: The role of perceived thought control ability. *Cognitive Behaviour Therapy*, 38, 16-28.
- Ranganath, C., Cohen, M. X., & Brozinsky, C. J. (2005). Working memory maintenance contributes to long-term memory formation: Neutral and behavioral evidence. *Journal of Cognitive Neuroscience*, 17, 994-1010.
- Rey, A., Marchand, F., Rappaz, R., Richelle, M., & Schaechtlin, M. (1957). Centration soutenue sur une tâche intellectuelle simple: Ordination continue de chiffres. *Archives de Psychologie*, 36, 29-61.
- Sarason, I. G., Pierce, G. R., & Sarason, B. R. (1996). Domains of cognitive interference. In I. G. Sarason, G.R. Pierce, & B.P. Sarason (Eds.), *Cognitive interference: Theories, methods, and findings* (pp. 139-152). Mahwah, NJ: Erlbaum.
- Schooler, J. W., Reichle, E. D., & Halpern, D. V. (2004). Zoning out while reading: Evidence for dissociations between experience and metaconsciousness. In D. T. Levin (Ed.), *Thinking and seeing: Visual metacognition in adults and children* (pp. 203-226). London, England: MIT Press.
- Schooler, J. W., Smallwood, J., McSpadden, M., & Reichle, E. D. (2005). *Reading nonsense*. Unpublished manuscript.
- Silverstein, S. M., Spaulding, W. D., Menditto, A. A., Savitz, A., Liberman, R. P., Berten, S., & Starobin, H. (2009). Attention shaping: A reward-based learning method to enhance skills training outcomes in schizophrenia. *Schizophrenia Bulletin*, 35, 222-232.
- Smallwood, J., & Schooler, J. W. (2006). The restless mind. *Psychological Bulletin*, 132, 946-958.
- Valmaggia, L. R., Bouman, T. K., & Schuurman, L. (2007). Attention training with auditory hallucinations: A case study. *Cognitive and Behavioral Practice*, 14, 127-133.
- Van der Linden, M., Adam, S., Agniel, A., Baisset-Mouly, C., Bardet, F., Coyette, F., ... Thomas-Anterion, C. (2004). *L'évaluation des troubles de la mémoire: Présentation de quatre tests de mémoire épisodique (avec leur étalonnage)*. Marseille, France: Solal.
- Wechsler, D. (2000). *WAIS-III: Echelle d'intelligence de Wechsler pour adultes* [Adult Intelligence Scale] (3rd ed.). Paris, France: Les éditions du Centre de Psychologie.
- Wechsler, D. (2001). *MEM-III: Manuel de l'échelle clinique de mémoire* [MEM-III: Wechsler Memory Scale] (3rd ed.). Paris, France: Les éditions du Centre de Psychologie.
- Wegner, D. M., & Zanakos, S. (1994). Chronic thought suppression. *Journal of Personality*, 62, 615-640.
- Wells, A. (2000). *Emotional disorders and metacognition: Innovative cognitive therapy*. Chichester, UK: Wiley.
- Wells, A. (2005). Detached mindfulness in cognitive therapy: A metacognitive analysis and ten techniques. *Journal of Rational-Emotive Cognitive-Behavior Therapy*, 23, 337-355.
- Wells, A. (2007). The attention training technique: Theory, effects and a metacognitive hypothesis on auditory hallucinations. *Cognitive and Behavioral Practice*, 14, 138.
- Wells, A., & Matthews, G. (1994). *Attention and emotion: A clinical perspective*. Hove, UK: Erlbaum.
- Wells, A., White, J., & Carter, K. (1997). Attention training: Effects on anxiety and beliefs in panic and social phobia. *Clinical Psychology and Psychotherapy*, 4, 226-232.
- Wykes, T., Reeder, C., Williams, C., Corner, J., Rice, C., & Everitt, B. (2003). Are the effects of cognitive remediation therapy (CRT) durable? Results from an exploratory trial in schizophrenia. *Schizophrenia Research*, 61, 163-174.
- Zimmerman, P., & Fimm, B. (1994). *Test for Attentional Performance (TAP)*. Herzogenrath, Germany: PsyTest.